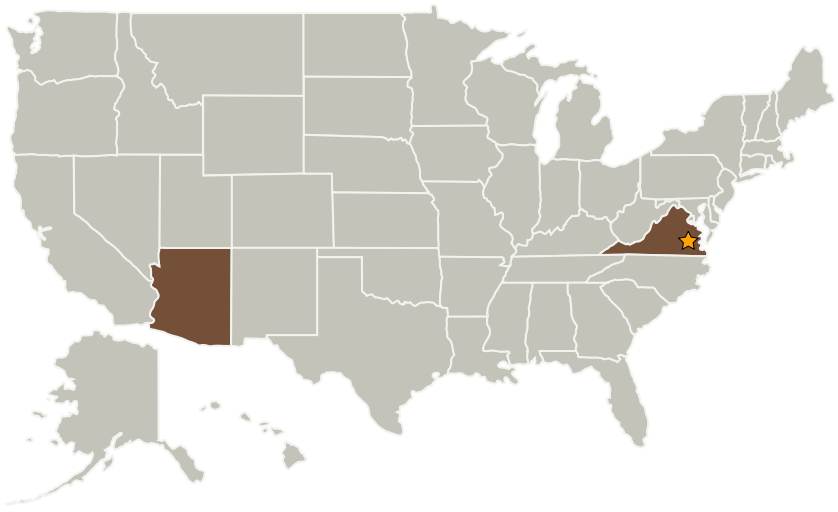
# ZEUS-DO: A Design Oriented CFD-Based Unsteady Aerodynamic Capability for Flight Vehicle Multidisciplinary Configuration Shape Optimization, Phase II

Completed Technology Project (2009 - 2011)

## Project Introduction

CFD-based design-oriented (DO) steady/unsteady aerodynamic analysis tools for Aeroelastic / Aeroservoelastic (AE/ASE) evaluation lag significantly behind other multidisciplinary design optimization (MDO) developments for flight vehicle design. In practically all studies to date involving configuration multidisciplinary shape optimization, dynamic AE/ASE constraints were left out, thus, rendering the design results incomplete. Flutter, gust stresses, vibration, fatigue, ride comfort, handling qualities -- all extremely important -- still cannot be accounted for in an automated design process involving configuration shape variations. Proposed here is the creation of a comprehensive design-oriented CFD-based unsteady-aerodynamic methodology to enhance current flight vehicle shape MDO capabilities by the creation of AE/ASE shape sensitivities and efficient approximations tailored for large-scale design optimization. ZONA Technology's proven ZEUS code serves as the aerodynamic base for this development. In Phase II aerodynamic shape sensitivities for AE/ASE shape optimization will be developed for general 3D configurations made of lifting surfaces and bodies. The subsonic, transonic, supersonic, and hypersonic flight regimes will be covered. Integration with shape optimization finite-element structural codes will be demonstrated, covering diverse AE/ASE constraints including flutter and gust response. This new general capability will fit any aerospace vehicle MDO environment, and will provide a critically needed MDO building block.

## Primary U.S. Work Locations and Key Partners

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| Organizations Performing Work | Role | Type | Location |
|---|---|---|---|
| ★Langley Research Center(LaRC) | Lead Organization | NASA Center | Hampton, Virginia |
| ZONA Technology, Inc. | Supporting Organization | Industry<br>Small Disadvantaged Business (SDB) | Scottsdale, Arizona |

| Primary U.S. Work Locations | |
|---|---|
| Arizona | Virginia |

## Project Transitions

**December 2009:** Project Start

**December 2011:** Closed out

## Organizational Responsibility

**Responsible Mission Directorate:**

Space Technology Mission Directorate (STMD)

**Lead Center / Facility:**

Langley Research Center (LaRC)

**Responsible Program:**

Small Business Innovation Research/Small Business Tech Transfer

## Project Management

**Program Director:**

Jason L Kessler

**Program Manager:**

Carlos Torrez

## Technology Areas

**Primary:**

- TX15 Flight Vehicle Systems
  - TX15.1 Aerosciences
    - TX15.1.3 Aeroelasticity